Appendix XIV.4-I

Debris Washer
Process Description

APPENDIX XIV.4-I DEBRIS WASHER PROCESS DESCRIPTION

I. Description of Treatment Equipment

The debris washer is a new piece of equipment that will be installed in the Building 695 LWP area. The descriptions and requirements listed in this appendix are based on the proposed design criteria for this equipment. Currently, treatment equipment that is commercially available from various vendors is being evaluated to determine which equipment may be best-suited for treating LLNL-generated debris. If required, treatability studies will be conducted prior to making a final decision on the equipment to be purchased. Should the commercially available systems are not adequate, HWM may have a customized system fabricated or pursue other technologies. All numerical values provided in this process description are approximate and are representative of the proposed design criteria. Specific design limitations that will not be exceeded without prior DTSC approval will be identified after purchase and installation.

I.1 Purpose

The purpose of the debris washer is to remove hazardous and/or radioactive contaminants from debris in compliance with the LDR treatment standards listed in 22 CCR 66268.45. The debris washer is considered to be a chemical extraction technology (e.g., water washing/spraying and liquid phase solvent extraction). As such, the washed (e.g., treated) debris can be managed non-radioactive and/or non-hazardous material if the performance, design, and operating criteria listed in Table 1 of 22 CCR 66268.45 is met. The regulatory criteria is provided in Section II.1 of this appendix for reference.

I.2 Equipment Operations

A proposed process flow concept for the debris washer is provided as **Figure 1.** The debris washer is a liquid extraction process that will consist of a wash water feed tank; a washing chamber; a heating/drying element; and associated pumps, pipes, and mixing equipment. The treatment equipment will be erected on a transportable skid.

The debris will be treated in batches. Maximum batch size is expected to be approximately 180 lb or 3 cu. ft. A forklift will typically be used to transport closed containers of debris waste to the washer. Certain debris (i.e., brick, cloth, concrete, paper, pavement, rock, and wood) will be size reduced in the shredder/chopper, when required, to meet the regulatory mandated thickness limitation [i.e., no more than 1.2 cm (1/2 in) in one dimension] prior to treatment in the debris washer. The contents of the waste container will be emptied into the washing chamber. The forklift may be used to elevate the waste containers to facilitate the emptying process. When the washing chamber is filled, the top is closed and sealed.

The washing solution is pumped into to the chamber from the wash water tank. The wash water tank will only be used to prepare the wash solution and will not contain hazardous waste. The composition of the washing solution will be determined by the HWM review chemist or process

engineer considering previous operating experience, the type of debris, and nature and characteristics of the contamination. At the present time, it is anticipated that the wash solution will either contain an acid or a surfactant. Nitric or sulfuric acid will be used to leach metals and break down heavy organics. Detergents or other surfactants will be used to enhance removal of dirt or organic material. Other types of solvents, including organic solvents, may be used to extract specific target contaminants. For certain debris (i.e., brick, cloth, concrete, paper, pavement, rock, and wood), the solubility of the contaminants in the washing/extraction solution are required by regulation to be at least 5% by weight.

The washing chamber will be agitated and/or have spray nozzles to ensure that all of the debris surfaces uniformly come in contact with the wash solution. The washing solution may also be heated to increase the solubility of the contaminants. For certain debris (i.e., brick, cloth, concrete, paper, pavement, rock, and wood), the contact time between the debris and the washing/extraction solution is required by regulation to be at least 15 minutes.

After the washing cycle is completed, the wash water will be pumped from the chamber into a waste container or portable tank. The debris may undergo subsequent washing cycles with the same or another solution, or may be rinsed to remove washing solution residuals. The disposition of the spent wash and rinse waters (i.e., tank farm, sewer discharge) will be based on analytical results. The debris are then dried. The two drying options being considered are to install an electrical heating element located within the chamber or to pass heated air through the chamber. It is expected that temperatures up to 300˚F can be maintained with either option. Following drying, the treated debris will be removed from the washing chamber and placed into a waste container. Off-gases will be treated as described in **Part XIV.4.3.3** of this permit application.

I.3 Types of Waste to be Treated

The types of hazardous wastes to be managed in the debris washer are listed in the **Part A and Table XIV.4-2.** As defined in 22 CCR 66260.10, debris are solid materials exceeding an average particle size of 60 mm (≈2.4 inches) that are intended for disposal. Hazardous debris must be a manufactured product, plant or animal matter, or a natural geologic material that either exhibits a hazardous waste characteristic (ignitability , corrosivity, reactivity, or toxicity) or is contaminated with a prohibited listed waste. The LLNL-generated debris are expected to be contaminated with volatile or heavy organics, tars, or heavy metals.

II. Effectiveness of Treatment

II.1 Treatment Performance Information

The debris washer is considered to be a chemical extraction technology. As such, the washed (e.g., treated) debris is not considered to be a hazardous waste if:

- The debris is treated to the "clean surface" LDR performance standard[1];

[1]Per this standard, the treated debris are to be free of all visible contaminated soil and hazardous waste except for residual staining (e.g., light shadows, slight streaks, and minor discoloration) and soil/waste (in cracks, crevices, and pits) that is less than 5% of each square inch of surface area.

• The debris is size reduced prior to washer so that the thickness, in one dimension, of the debris does not exceed 1.2 centimeters;

• The contact time between the debris and the washing or extraction solution is at least 15 minutes; and

• The solubility of the hazardous waste contaminants in the washing or extraction solution is at least 5% by weight.

The "clean surface" performance standard and thickness limitation will be verified by visual inspection. A timer will be provided to track the washing duration. The treatment sequence and duration will be determined by the HWM review chemist or process engineer. Publications, such as the *CRC Handbook of Chemistry and Physics*, will be consulted to ensure that the solubility target contaminants in the selected extraction solution are at least 5% by weight. When required, the solubility information and treatment duration will be documented in the HWM prepared treatment plan. If the size reduced debris no longer meet the debris definition (e.g., average particle diameter size of 60 mm.), the waste-specific LDR treatment standards will be used as the basis for the effectiveness of the treatment process.

A cold test run will be performed to test the solids handling equipment, pumps, heating system, and instrumentation. Conditions during this test will be the same as normal operation, except that in lieu of contaminated debris, a surrogate waste will be prepared. The test will ensure that all moving parts of the mechanism function correctly, that adequate temperatures are achieved, and that the instrumentation and control system operates as designed. Once hazardous operations commence, samples will be collected and analyzed only when required to solve reoccurring equipment problems.

II.2 Process Controls

The debris washer will have instruments, a programmable logic controller (PLC), and a control panel to monitor and/or adjust the items listed below. The debris washer will normally be manually operated.

• A temperature element will be provided in the washing chamber to automatically control the temperature of the washing solution and drying cycle. The PLC will use the temperature readings to control the power to the heating elements. The operator will pre-set the warning alarms to ensure that the washing process temperatures are maintained within any requirements specified in the OSP, SOP, and/or treatment plan.

• The head space of the washing chamber will be monitored to ensure that the off-gas system is maintaining a slight negative pressure.

• Flow rate and total volume of wash water to the chamber will be monitored. The operator will be able to control the position (open/closed) of the control valves between the wash water hold tank and the washing chamber, and washing chamber drain.

• Liquid level and pH in wash water tank and washing chamber will be monitored.

- The operation (on/off) of the agitation system will be displayed on and switched from the control panel. Depending on the type of agitation mechanism selected, an out-of-balance alarm will be provided.

- A timer will be provided on the control panel to track the elapsed treatment time.

II.3 Inspections and Maintenance

Operators will also be properly trained prior to being allowed to operate the debris washer unsupervised. A pre-operational safety inspection will be conducted each day that the debris washer is to be used. At a minimum, the following items will be visually inspected:

- Wear and damage of moving parts, especially the integrity of the washing chamber;

- General condition of the system (e.g., loose fittings or bolts, frayed wires, worn or broken seals, duct damage, clear access, etc.); and

- Proper function of instruments, alarms, interlocks, and emergency shut-off controls, including the setting of all operator alarm set points in accordance of the treatment plan.

III. Equipment Specifications

The debris washer will be self-contained and skid-mounted. The debris washer will consist of a washing chamber, a wash water mixing tank, and associated piping and pumps. All hardware and local controls will be located on the skid. Electric power, process water, and instrument air will be supplied to the debris washer from the Building 695 utility systems. A manufacturer for this equipment has not been identified; as such, skid dimensions, cross-sectional views, and photographs cannot be provided.

The proposed design criteria for the debris washer are listed below. Although these criteria are provided to be representative of the equipment to be installed in the Building 695 S/TUG, deviations may be required to match off-the-shelf items. If required, the design specifications for the equipment to be installed will be submitted to DTSC for approval as a Class 1 permit modification prior to implementing the change.

III.1 Washing Chamber

The washing chamber will be a cylindrical vessel that will have an internal volume of approximately 10 cu. ft. The processing capacity is based on one 3 cu. ft. batch per hour of debris. Type 300 stainless steel was chosen as the material of construction since it resists corrosion from nitric and sulfuric acids and common surfactants. The chamber will have a top or front opening that will have adequate clearance for loading and unloading. A door gasket will be provided to ensure that fugitive participates and other off-gases do not exit the chamber except through the vent. The heating elements will be sized to raise the temperature inside the washing chamber to 300˚F. The chamber will be insulated, as necessary, to protect personnel from burns.

~~III.2 Wash Water Mixing Tank~~

~~The wash water tank will have a capacity of approximately 25 gallons and will also be constructed from Type 300 stainless steel. The wash water pump will be able to deliver liquid to the chamber at a rate of 2 gpm.~~

~~IV. Equipment Drawings~~

~~Because a manufacturer for the fabrication of this equipment has not been identified, equipment drawings cannot be provided. If required, design drawings will be submitted to DTSC for approval as a permit modification prior to installing the equipment.~~

DWTF Debris Washer

INTRODUCTION

The Radioactive and Hazardous Waste Management (RHWM) Waste Treatment Group (WTG) plans to install and operate a Debris Washer in the Decontamination and Waste Treatment Facility (DWTF). Resource Conservation and Recovery Act (RCRA) regulations require that hazardous waste with specific hazardous constituents must first be treated to meet Land Disposal Restrictions (LDRs) requirements. In order to meet these requirements, WTG plans to use water washing and spraying as a means of chemical extraction as specified in 22 CCR 66268.45, Table 1 (A0(2)(a). Although this is a treatment method for hazardous waste, LLNL will use it to treat both hazardous and mixed wastes.

The debris will be washed with high-pressure hot water that may contain dilute concentrations of surfactants, detergents, acids or bases. The debris will then be allowed to dry after which it will be dumped into a standard waste box and prepared for off-site disposal. The wastewater from the washing process will be collected and managed as required by regulations. The debris washing will take place in B695, room 1036.

EQUIPMENT DESCRIPTIONS

Debris-Washing Box

This is the container in which the debris will be washed. The overall dimensions of the box are approximately 48”x 61”x 82” as shown in Figure 1. All debris-contacting surfaces are made of 304-stainless steel. As shown in Figure 2, the lid contains two pipe manifolds, each containing four nozzles. Each manifold has a quick-disconnect fitting where a high-pressure water hose can be connected. Also on the lid is an orifice for connecting the box up to the ductwork leading to the Pollution Off-Gas System (POGS). A flexible duct will be connected to the ductwork in R1036 at one end while the other end will be attached to the lid. The wash water from the nozzles is sprayed into the box and washes through the debris, which is on top of a perforated plate. As the water passes through the perforated plate the sloped bottom directs the wash water toward the front of the box where a drain is located.

Container Lift and Dump Station

This is a hydraulic lift and dump system. It is capable of handling the special size of the debris-washing box, but can also handle the standard 4’x4’x7’ box sizes that RHWM uses. The

maximum lift capacity is 15,000 pounds. The unit can lift a box vertically to 67" and maintain this height. From the lifted position, the box can either be lowered or rotated 135 degrees to dump the contents. There is a chute on the back of the station, which directs the debris into another box. This stationary unit will be anchored to the concrete floor.

Hot Water Pressure Washers

The two units are totally electric powered hot water, high-pressure washers. They produce a flow rate of approximately 2.3 gpm at a pressure of approximately 1200 psi. They have a maximum water temperature of 170˚ F, but will maintain a temperature around 155˚F during operation.

Receiving Boxes

The debris-washing box was designed to have an internal capacity that closely matches that of a standard 4'x4'x7' box, which is 112 ft^3. This is because most of the time the contents of the debris-washing box will be dumped into a standard HWM 4'x4'x7' box. RHWM has several vendors that supply these boxes, so the actual dimensions of a 4'x4'x7' box vary by approximately 6".

Figure1: Debris-Washing Box

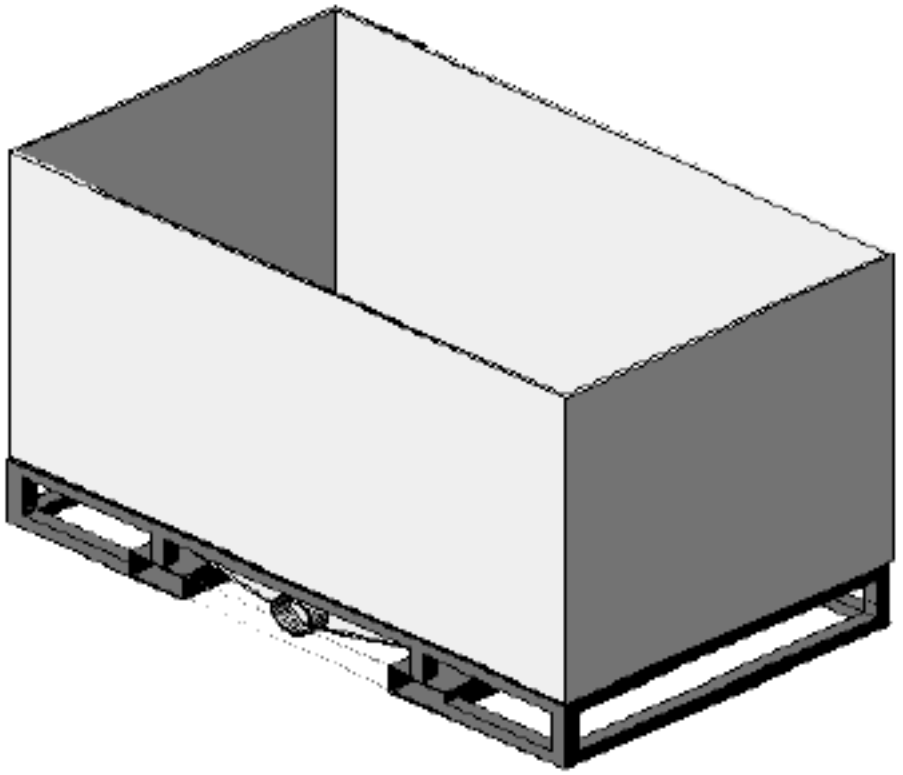
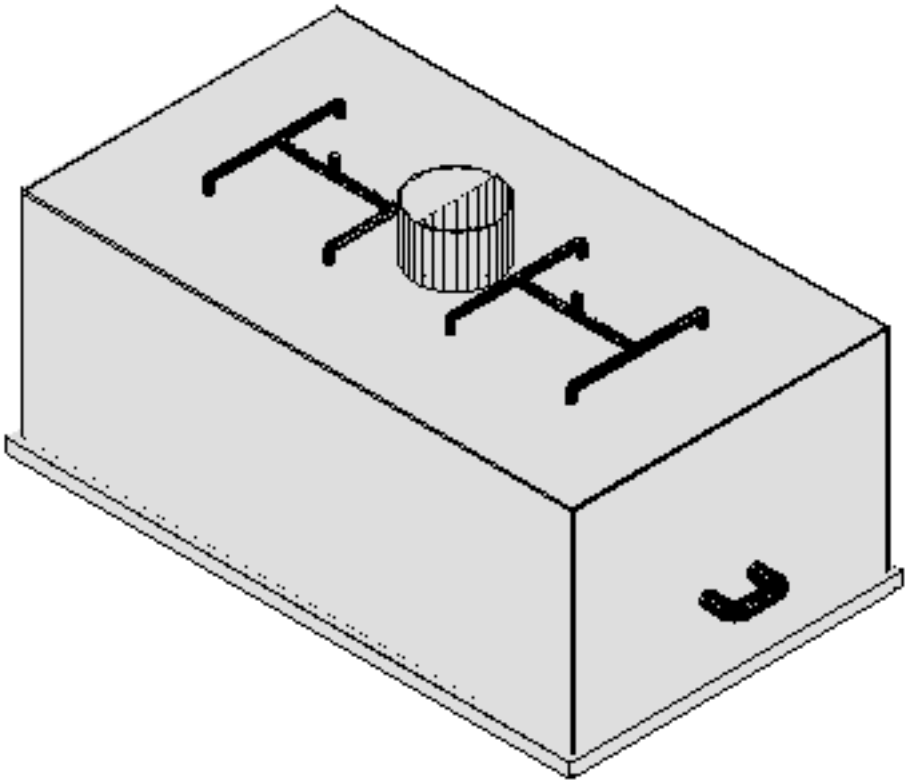


Figure 2: Debris-Washing Box Lid



PROCESS DESCRIPTION

In general, debris from the chopper/shredder will be discharged directly into the debris-washing box. However, there may be times when the debris will be collected in other containers first and then dumped into the debris-washing box at a later time. In either case, the debris-washing box will be moved by a forklift into room 1036. The hot water pressure washer hoses will then be connected to the box lid, followed by the flexible exhaust duct. The lid will then be attached to the debris-washing box.

The valve controlling the air exhaust from the Debris Washer to the POG system will be closed at all times except during the drying stage. When closed, the valve allows a leak rate of approximately 180 cfm and when opened the flow rate is around 1500 cfm. The valve is kept closed most of the time in order to prevent water from entering the ductwork during the washing stage and to prevent clean air from entering the POGS where it will reduce capacity that may be needed for other processes.

Once the lid is attached to the debris-washing box, the box is transferred by a forklift into the bucket of the lift and dump station. The box is then raised a vertical distance of 67". A 660-gallon portable tank will then be placed at the front of the lift and dump station and a flexible hose will be connected from the drain of the debris-washing box and directed into the top of the portable tank. At this point the valve controlling the duct leading to the POGS will be verified closed, and then the high-pressure hot water washers will be turned on. The length of time

required for washing is variable depending upon the type of waste being washed. Portable tanks will be switched out as needed based on degree of washing required. In order to help in the removing of hazardous constituents, the pressurized hot water may contain detergents, surfactants and/or dilute concentrations of acids and bases.

After washing has taken place, the drain hose will be removed and the valve controlling the duct leading to the POG system will be opened. This will cause air to be drawn into the debris-washing box from the bottom, and through the debris, which will remove water moisture.

After the debris has dried, the box will be lowered and the lid will be removed. The box will then be raised again, but this time it will also be rotated and dumped. Due to space limitations, a forklift cannot deliver a receiving box to the backside of the lift and dump station. Therefore, a cart will be placed on the side of the lift and dump station where the receiving box will be placed using a forklift. This cart will then be manually wheeled to the backside of the lift and dump station.

Figure ~~III~~3: Process Flow Scheme